WILLIAM BARTON ROGERS.

WILLIAM BARTON ROGERS was born at Philadelphia, on the 7th of December, 1804. His father, Patrick Kerr Rogers, was a native of Newton Stewart, in the north of Ireland; but while a student at Trinity College, Dublin, becoming an object of suspicion on account of his sympathy with the unfortunate Robert Emmet, he emigrated to this country, and finished his education in the University of Pennsylvania, at Philadelphia, where he received the degree of Doctor of Medicine.

Here he married Hannah Blythe, a Scotch lady, — who was at the time living with her aunt, Mrs. Ramsay, — and settled himself in his profession in a house on Ninth Street, opposite to the University; and in this house William B. Rogers was born. He was the second of four sons, — James, William, Henry, and Robert, — all of whom became distinguished as men of science.

Patrick Kerr Rogers, finding that his prospects of medical practice in Philadelphia had been lessened in consequence of a protracted absence in Ireland, made necessary by the death of his father, removed to Baltimore; but soon afterwards accepted the Professorship of Chemistry and Physics in William and Mary College, Virginia, made vacant by the resignation of the late Robert Hare; and it is a fact worthy of notice, that, while he succeeded Dr. Hare at William and Mary College, his oldest son, James, succeeded Dr. Hare at the University of Pennsylvania. At William and Mary College the four brothers Rogers were educated; and on the death of the father, at Ellicott Mills, in 1828, William B. Rogers succeeded to the professorship thus made vacant.

He had already earned a reputation as a teacher by a course of lectures before the Maryland Institute in Baltimore during the previous year, and after his appointment at once entered on his career as a scientific investigator. At this period he published a paper on Dew, and, in connection with his brother Henry, another paper on the Voltaic Battery, — both subjects directly connected with his professorship. But his attention was early directed to questions of chemical geology; and he wrote, while at William and Mary College, a series of articles for the Farmer's Register on the Green Lands and Marls of Eastern Virginia, and their value as fertilizers. Next we find the young Professor going before the legislature of Virginia, and, while modestly presenting his own discoveries, making them the occasion for urging upon that body the importance of a systematic geological survey for

developing the resources of the State. So great was the scientific reputation that Professor Rogers early acquired by such services, that in 1835 he was called to fill the important Professorship of Natural Philosophy and Geology in the University of Virginia; and during the same year he was appointed State Geologist of Virginia, and began those important investigations which will always associate his name with American geology.

Professor Rogers remained at the head of the Geological Survey of Virginia until it was discontinued, in 1842, and published a series of very valuable annual reports. As was anticipated, the survey led to a large accumulation of material, and to numerous discoveries of great local importance. As this was one of the earliest geological surveys undertaken in the United States, its directors had in great measure to devise the methods and lay out the plans of investigation which have since become general. This is not the place, however, for such details; but there are four or five general results of Professor Rogers's geological work at this period which have exerted a permanent influence on geological science, and which should therefore be briefly noticed. Some of these results were first published in the American Journal of Science; others were originally presented to the Association of American Geologists and Naturalists, and published in its "Transactions." Professor Rogers took a great interest in the organization of this association in 1840, presided over its meeting in 1845, and again, two years later, when it was expanded into the American Association for the Advancement of Science.

In connection with his brother Robert, Professor William B. Rogers was the first to investigate the solvent action of water — especially when charged with carbonic acid — on various minerals and rocks; and by showing the extent of this action in nature, and its influence in the formation of mineral deposits of various kinds, he was one of the first to observe and interpret the important class of facts which are the basis of chemical geology.

Another important result of Professor Rogers's geological work was to show that the condition of any coal-bed stands in a close genetic relation to the amount of disturbance to which the enclosing strata have been submitted, the coal becoming harder and containing less volatile matter as the evidence of disturbance increases. This generalization, which seems to us now almost self-evident, — understanding, as we do, more of the history of the formation of coal, — was with Professor Rogers an induction from a great mass of observed facts.

By far, however, the most memorable contribution of Professor Rogers to geology was that made in connection with Henry D. Rogers, in a paper entitled "The Laws of Structure of the more Disturbed Zones of the Earth's Crust," presented by the two brothers at the meeting of the Association of American Geologists and Naturalists, held at Boston in 1842. This paper was the first presentation of what may be called in brief the Wave Theory of Mountain Chains. This theory was deduced by the brothers Rogers from an extended study of the Appalachian chain in Pennsylvania and Virginia, and was supported by numerous geological sections and by a great mass of facts. The hypothesis which they offered as an explanation of the origin of the great mountain waves may not be generally received; but the general fact that the structure of mountain chains is alike in all the essential features which the brothers Rogers first pointed out, has been confirmed by the observations of Murchison in the Ural, of Darwin in the Andes, and of the Swiss geologists in the Alps. "In the Appalachians the wave structure is very simple, and the same is true in all corrugated districts where the crust movements have been simple, and have acted in one direction only. But where the elevating forces have acted in different directions at different times, causing interference of waves like a chopped sea, as in the Swiss Alps and the mountains of Wales or Cumberland, the undulations are disguised, and are with extreme difficulty made out." The wave theory of mountain chains was the first important contribution to dynamical and structural geology which had been brought forward in this country. It excited at the time great interest, as well from the novelty of the views as from the eloquence with which they were set forth; and to-day it is still regarded as one of the most important advances in orographic geology.

A marked feature of mountain regions is that rupturing of the strata called faults; and another of the striking geological generalizations of the brothers Rogers is what may be called the law of the distribution of faults. They showed that faults do not occur on gentle waves, but in the most compressed flexures of the mountain chains, which in the act of moving have snapped or given way at the summit where the bend is sharpest, the less inclined side being shoved up on the plane of the fault, this plane being generally parallel to, if it does not coincide with, the axis plane; and, further, that "the direction of these faults generally follows the run of the line of elevation of the mountains, the length and vertical displacement depending on the strength of the disturbing force."

The last of the general geological results to which we referred

above was published under the name of William B. Rogers only. It was based on the observed positions of more than fifty thermal springs in the Appalachian belt, occurring in an area of about fifteen thousand square miles, which were shown to issue from anticlinal axes and faults, or from points very near such lines; and in connection with these springs it was further shown that there was a great preponderance of nitrogen in the gases which the waters held in solution.

It must be remembered that, during the time when this geological work was accomplished, Professor Rogers was an active teacher in the University of Virginia, giving through a large part of the year almost daily lectures either on physics or geology. Those who met him in his after life in various relations in Boston, and were often charmed by his wonderful power of scientific exposition, can readily understand the effect he must have produced, when in the prime of manhood, upon the enthusiastic youths who were brought under his influence. His lecture-room was always thronged. As one of his former students writes, "All the aisles would be filled, and even the windows crowded from the outside. In one instance I remember the crowd had assembled long before the hour named for the lecture, and so filled the hall that the Professor could only gain admittance through a side entrance leading from the rear of the hall through the apparatus-room. These facts show how he was regarded by the students of the University of Virginia. His manner of presenting the commonest subject in science — clothing his thoughts, as he always did, with a marvellous fluency and clearness of expression and beauty of diction — caused the warmest admiration, and often aroused the excitable nature of Southern youths to the exhibition of enthusiastic demonstrations of approbation. Throughout Virginia, and indeed the entire South, his former students are scattered, who even now regard it as one of the highest privileges of their lives to have attended his lectures."

Such was the impression which Professor Rogers left at the University of Virginia, that, when he returned thirty-five years later to aid in the celebration of the semi-centennial, he was met with a perfect ovation. Although the memories of the civil war, which had intervened, and Professor Rogers's known sympathies with the Northern cause, might well have damped enthusiasm, yet the presence of the highly honored teacher was sufficient to rekindle the former admiration; and, in the language of a contemporary Virginia newspaper, "the old students beheld before them the same William B. Rogers who thirty-five years before had held them spellbound in his class of natural philosophy; and as the great orator warmed up, these men

forgot their age; they were again young, and showed their enthusiasm as wildly as when, in days of yore, enraptured by his eloquence, they made the lecture-room of the University ring with their applause."

Besides his geological papers, Professor Rogers published, while at the University of Virginia, a number of important chemical contributions, relating chiefly to new and improved methods in chemical analysis and research. These papers were published in connection with his youngest brother, Robert E. Rogers, now become his colleague as Professor of Chemistry and Materia Medica in the University; and such were the singularly intimate relations between the brothers that it is often impossible to dissociate their scientific work. Among these were papers "On a New Process for obtaining Pure Chlorine"; "A New Process for obtaining Formic Acid, Aldehyde, etc."; "On the Oxidation of the Diamond in the Liquid Way"; "On New Instruments and Processes for the Analysis of the Carbonates"; "On the Absorption of Carbonic Acid by Liquids"; besides the extended investigation "On the Decomposition of Minerals and Rocks by Carbonated and Meteoric Waters," to which we have referred above. There was also at this time a large amount of chemical work constantly on hand in connection with the Geological Survey, such as analyses of mineral waters, ores, and the like. Moreover, while at the University of Virginia, Professor Rogers published a short treatise on "The Strength of Materials," and a volume on "The Elements of Mechanics," — books which, though long out of print, were very useful text-books in their day, and are marked by the clearness of style and felicity of explanation for which the author was so distinguished.

The year 1853 formed a turning-point in Professor Rogers's life. Four years previously he had married Miss Emma Savage, daughter of Hon. James Savage of Boston, the well-known author of the New England Genealogical Dictionary, and President of the Massachusetts Historical Society. This connection proved to be the crowning blessing of his life. Mrs. Rogers, by her energy, her intelligence, her cheerful equanimity, her unfailing sympathy, became the promoter of his labors, the ornament and solace of his middle life, and the devoted companion and support of his declining years. Immediately after his marriage, June 20, 1849, he visited Europe with his wife, and was present at the meeting of the British Association for the Advancement of Science, held that year at Birmingham, where he was received with great warmth, and made a most marked impression. Returning home in the autumn, Professor Rogers resumed his work at the University

of Virginia; but the new family relations which had been established led in 1853 to the transfer of his residence to Boston, where a quite different, but even a more important, sphere of usefulness surrounded him. His wide scientific reputation, as well as his family connection, assured him a warm welcome in the most cultivated circles of Boston society, where his strength of character, his power of imparting knowledge, and his genial manners, soon commanded universal respect and admiration. He at once took an active part in the various scientific interests of the city. From 1845 he had been a Fellow of this Academy; and after taking up his residence among us he was a frequent attendant on our meetings, often took part in our proceedings, became a member of our Council, and from 1863 to 1869 acted as our Corresponding Secretary. He took a similar interest in the Boston Society of Natural History. He was a member, and for many years the President, of the Thursday Evening Scientific Club, to which he imparted new life and vigor, and which was rendered by him an important field of influence. The members who were associated with him in that club will never forget those masterly expositions of recent advances in physical science; and will remember that, while he made clear their technical importance to the wealthy business men around him, he never failed to impress his auditors with the worth and dignity of scientific culture.

During the earlier years of his residence in Boston, Professor Rogers occupied himself with a number of scientific problems, chiefly physical. He studied the variations of ozone (or of what was then regarded as ozone) in the atmosphere at the time when this subject was exciting great attention. He was greatly interested in the improvements of the Ruhmkorff Coil made by Mr. E. S. Ritchie; and in this connection published a paper on the "Actinism of the Electric Discharge in Vacuum Tubes." A study of the phenomena of binocular vision led to a paper entitled "Experiments disproving by the Binocular Combination of Visual Spectra Brewster's Theory of Successive Combinations of Corresponding Points." A paper discussing the phenomena of smoke rings and rotating rings in liquids appeared in the American Journal of Science for 1858, with the description of a very simple but effective apparatus by which the phenomena would be readily reproduced. In this paper Professor Rogers anticipated some of the later results of Helmholtz and Sir William Thomson. In the same year an ingenious illustration of the properties of sonorous flames was exhibited to the Thursday Evening Club above mentioned, in which Professor Rogers anticipated Count Schafgottsch in the invention of a

beautiful optical proof of the discontinuity of the singing hydrogen flame.

In 1861 Professor Rogers accepted from Governor Andrew the office of Inspector of Gas and Gas-Meters for the State of Massachusetts, and organized a system of inspection in which he aimed to apply the latest scientific knowledge to this work; and in a visit he again made to Europe in 1864 he presented, at the meeting of the British Association at Bath, a paper entitled "An Account of Apparatus and Processes for Chemical and Photometrical Testing of Illuminating Gas."

During this period he gave several courses of lectures before the Lowell Institute of Boston, which were listened to with the greatest enthusiasm, and served very greatly to extend Professor Rogers's reputation in this community. Night after night, crowded audiences, consisting chiefly of teachers and working-people, were spellbound by his wonderful power of exposition and illustration. There was a great deal more in Professor Rogers's presentation of a subject than felicity of expression, beauty of language, choice of epithets, or significance of gesture. He had a power of marshalling facts, and bringing them all to bear on the point he desired to illustrate, which rendered the relations of his subject as clear as day. In listening to this powerful oratory one only felt that it might have had, if not a more useful, still a more ambitious aim; for less power has moved senates and determined the destinies of empires.

The interest in Professor Rogers's lectures was not excited solely, however, by the charm of his eloquence; for, although such was the felicity of his presentations, and such the vividness of his descriptions, that he could often dispense with the material aids so essential to most teachers, yet when the means of illustration were at his command he showed his power quite as much in the adaptation of experiments as in the choice of language. He well knew that experiments, to be effective, must be simple and to the point; and he also knew how to impress his audience with the beauty of the phenomena and with the grandeur of the powers of nature. He always seemed to enjoy any elegant or striking illustration of a physical principle even more than his auditors, and it was delightful to see the enthusiasm which he felt over the simplest phenomena of science when presented in a novel way.

We come now to the crowning and greatest work of Professor Rogers's life, the founding of the Massachusetts Institute of Technology, — an achievement so important in its results, so far-reaching

in its prospects, and so complete in its details, that it overshadows all else. A great preacher has said that "every man's life is a plan of God's." The faithful workman can only make the best use of the opportunities which every day offers; but he may be confident that work faithfully done will not be for naught, and must trustingly leave the issue to a higher power. Little did young Rogers think, when he began to teach in Virginia, that he was to be the founder of a great institution in the State of Massachusetts; and yet we can now see that the whole work of his life was a preparation for this noble destiny. The very eloquence he so early acquired was to be his great tool; his work on the Geological Survey gave him a national reputation which was an essential condition of success; his life at the University of Virginia, where he was untrammelled by the traditions of the older universities, enabled him to mature the practical methods of scientific teaching which were to commend the future institution to a working community; and, most of all, the force of character and large humanity developed by his varied experience with the world were to give him the power, even in the conservative State of his late adoption, to mould legislators and men of affairs to his wise designs.

It would be out of place, as it would be unnecessary, to dwell in this connection on the various stages in the development of the Institute of Technology. The facts are very generally known in this community, and the story has been already well told. The conception was by no means a sudden inspiration, but was slowly matured out of a far more general and less specific plan, originating in a committee of large-minded citizens of Boston, who in 1859, and again in 1860, petitioned the legislature of Massachusetts to set apart a small portion of the land reclaimed from the Back Bay "for the use of such scientific, industrial, and fine art institutions as may associate together for the public good." The large scheme failed; but from the failure arose two institutions which are the honor and pride of Boston, — the Museum of Fine Arts and the Institute of Technology. In the further development of the Museum of Fine Arts Professor Rogers had only a secondary influence; but one of his memorials to the legislature contains a most eloquent statement, often quoted, of the value of the fine arts in education, which attests at once the breadth of his culture and the largeness of his sympathies.

Although the committee of gentlemen above referred to had failed to carry out their general plan, yet the discussions to which it gave rise had developed such an interest in the establishment of an institution to be devoted to industrial science and education that they deter-

mined upon taking the preliminary steps towards the organization of such an institution. A sub-committee was charged with preparing a plan; and the result was a document, written by Professor Rogers, entitled "Objects and Plan of an Institute of Technology." That document gave birth to the Massachusetts Institute of Technology, for it enlisted sufficient interest to authorize the committee to go forward. A charter with a conditional grant of land was obtained from the legislature in 1861, and the institution was definitely organized, and Professor Rogers appointed President, April 8, 1862. Still, the final plans were not matured and it was not until May 30, 1864, that the government of the new institution adopted the report prepared by its President, entitled "Scope and Plan of the School of Industrial Science of the Massachusetts Institute of Technology," which Dr. Runkle has called the "intellectual charter" of the institution, and which he states "has been followed in all essential points to this very day." In striking confirmation of what we have written above, Dr. Runkle further says: —

"In this document we see more clearly the breadth, depth, and variety of Professor Rogers's scientific knowledge, and his large experience in college teaching and discipline. It needed just this combination of acquirements and experience to put his conceptions into working shape, to group together those studies and exercises which naturally and properly belong to each professional course, and thus enable others to see the guiding lines which must direct and limit their work in its relations to the demands of other departments. . . . .

"The experimental element in our school — a feature which has been widely recognized as characteristic — is undoubtedly due to the stress and distinctness given to it in the 'Scope and Plan.' In our discipline we must also give credit to the tact and large-heartedness of Professor Rogers in the fact that we are entirely free from all petty rules and regulations relating to conduct, free from all antagonism between teachers and students."

The associates of Professor Rogers in this Academy — many of them his associates also in the Institute of Technology, or in the Society of Arts, which was so important a feature of the organization — will remember with what admiration they watched the indefatigable care with which its ever active President fostered the young life of the institution he had created. They know how, during the earlier years, he bore the whole weight of the responsibility of the trust he had voluntarily and unselfishly assumed for the public good; how, while by his personal influence obtaining means for the daily support of the school,

he gave a great part of the instruction, and extended a personal regard to every individual student committed to his charge. They recall with what wisdom, skill, tact, and patience he directed the increasing means and expanding scope of the now vigorous institution, overcoming obstacles, reconciling differences, and ingratiating public favor. They will never forget how, when the great depression succeeded the unhealthy business activity caused by the civil war, during which the institution had its rise, the powerful influence of its great leader was able to conduct it safely through the financial storm. They greatly grieved when, in the autumn of 1868, the great man who had accomplished so much, but on whom so much depended, his nerves fatigued by care and overwork, was obliged to transfer the leadership to a younger man; and ten years later were correspondingly rejoiced to see the honored chief come again to the front, with his mental power unimpaired, and with adequate strength to use his well-earned influence to secure those endowments which the increased life of the institution required; and they rejoiced with him when he was able to transfer to a worthy successor the completed edifice, well established and equipped, — an enduring monument to the nobility of character and the consecration of talents. They have been present also on that last occasion, and have united in the acclamation which bestowed on him the title "Founder and father perpetual, by a patent indefeasible." They have heard his feeling but modest response, and have been rejoicing though tearful witnesses when, after the final seal of commendation was set, he fell back, and the great work was done.

We honor the successful teacher, we honor the investigator of nature's laws, we honor the upright director of affairs, — and our late associate had all these claims to our regard; but we honor most of all the noble manhood, — and of such make are the founders of great institutions. In comparison, how empty are the ordinary titles of distinction of which most men are proud! It seems now almost trivial to add that our associate was decorated with a Doctor's degree, both by his own University and also by the University at Cambridge; that he was sought as a member by many learned societies; that he was twice called to preside over the annual meetings of the American Association for the Advancement of Science; and that, at the death of Professor Henry, he was the one man of the country to whom all pointed as the President of the National Academy of Science. This last honor, however, was one on which it is a satisfaction to dwell for a moment, because it gave satisfaction to Professor Rogers, and the office was one which he greatly adorned, and for which his unusual oratorical abilities

were so well suited. He was a most admirable presiding officer of a learned society. His breadth of soul and urbanity of manner insensibly resolved the discords which often disturb the harmonies of scientific truth. He had the delicate tact so to introduce a speaker as to win in advance the attention of the audience, without intruding his own personality; and when a paper was read, and the discussion closed, he would sum up the argument with such clearness, and throw around the subject such a glow of light, that abstruse results of scientific investigation were made clear to the general comprehension, and a recognition gained for the author which the shrinking investigator could never have secured for himself. To Professor Rogers the truth was always beautiful, and he could make it radiant.

It is also a pleasure to record, in conclusion, that Professor Rogers's declining years were passed in great comfort and tranquillity, amidst all the amenities of life; that to the last he had the companionship of her whom he so greatly loved; and that increasing infirmities were tended and the accidents of age warded off with a watchfulness that only the tenderest love can keep. We delight to remember him in that pleasant summer home at Newport, which he made so fully in reality as in name the "Morning-side," that we never thought of him as old, and to believe that the morning glow which he so often watched spreading above the eastern ocean was the promise of the fuller day on which he has entered.

NATHANIEL THAYER.

NATHANIEL THAYER died at his residence in Boston, March 7, 1883, in the seventy-fifth year of his age, and his well-rounded life, ripe in experience as well as years, can be looked back upon as successful in all that gives that word its best significance. He was born in Lancaster, September 11, 1808, and was educated in the same place. His father, Rev. Dr. Nathaniel Thayer, was minister in that town for nearly fifty years. The very high character of his parents, and all the influences surrounding the years of his youth, tended to implant in the young man the genius that found so rich fruition as he grew to manhood. It is too true, that in the richest soil weeds are most apt to abound; and a parallel is often found in the waste of opportunities which should furnish the way to the best and highest development. In Mr. Thayer's case we see an instance where, from early youth, his tastes and inclinations led his sympathies into association only with the best, so that at all times it was a pleasure and a compliment to be